

I'm not a rancher!

What can I do to rebuild soil?

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I'm Not a Rancher! What Can I Do to Rebuild Soil?

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Preface: what's this about?

If you've heard a talk by Emporia's own Gail Fuller recently, or by Gabe Brown or Joel Salatin or Dr. Kristine Nichols or Dr. Christine Jones or Mark Shepard or Ray Archuleta or any number of other people, you may have learned the following things:

- The difference between soil and plain old dirt is the presence of humus;
- Soil microbes, working symbiotically with green plants, can store a tremendous amount of atmospheric carbon in the form of humus;
- Pretty much any agricultural problem can be solved by adding humus;
- Humus only forms in a healthy soil ecosystem; in unhealthy soil it decays

instead, escaping into the atmosphere and leaving the soil progressively worse;

- Many practices that are considered conventional, such as tilling and applying chemical fertilizers and pesticides, weaken the soil ecosystem that creates humus and so contribute to soil decay and climate change;
- So much soil has decayed during the past 150 years that we are in imminent danger of not being able to conduct agriculture much longer;
- The best way we know of to build healthy soil rapidly is by Managed Intensive Rotational Grazing (MIRG, also called mob grazing) of livestock on a diversity of plants.

But what if you're not a rancher? What can you do to help repair the soil? This book is a

quick guide to all the ways you can help. It is not meant to be comprehensive — see the glossary to learn more!

Thanks to Gail Fuller, Marcia Lawrence, and Sarah Cornell for their feedback in editing this book.

1. Test your soil organic matter

“If you don’t test, it’s just a guess.” These are words to live by, as much in everyday life as in scientific research. How will you know if what you’re doing for the soil is helping? By testing it, before and after. **You can even test your houseplants**, if you don’t have a lawn or garden!

Fortunately, soil tests are very easy to obtain. Just go to your local county extension agency, for example Lyon County Extension Office, and pick up some soil test bags. These come with the instructions conveniently printed on them. All you need is a shovel. Then return the full bags to your agency, and in a week or two you’ll have your results.

The cost of testing may vary depending on the time of year, so be sure to ask about that if money is a concern. For our purposes, **January or February is the best time to test**,

because we're interested primarily in the stable organic matter (humus) that can last through the winter, and if you test later in the year you are likely to get a figure that is inflated and less meaningful. Whatever time of year you test, be sure to do your "after" test at the same time of year as your "before" test.

What kind of numbers are you looking for? An organic matter percentage (%OM) of 2% or lower is sadly average for most of the country. 5% is great, and as your soil approaches 10% OM you will find you no longer need to water your garden except during prolonged droughts!

Along with your test results, your extension agent will offer you advice about what fertilizers -- chemical or organic -- to add to the soil to boost the nitrogen (N), phosphorus (P) and potassium (K) levels right away. I recommend you hold off on following that advice (see "Don't till or spray") and **focus on increasing the organic matter in the soil**

first. I'm willing to bet that your N, P, and K levels will increase right along with it, without your needing to add fertilizer!

If you're serious about testing soil fertility, there are better tests available. Gail recommends the Haney test, available from Ward Lab. Whichever type of test you use, stick with it, because the numbers are not comparable from one test type to another.

2. Landscape for water retention

Do you ever wonder why we landscape our homes and cities to get the rainwater away as quickly as possible, and then complain about flooding downstream and droughts upstream? We've turned one solution into two problems!

On any property, no matter how small, there's what we Americans call a **watershed** (more properly called a drainage basin): water that starts out dispersed flows together into one place. A bathtub is a great example of a drainage basin, and the peaked roof of a house is a great example of a drainage divide, where rain flows different directions depending on where it lands.

When rainwater leaves your property in a hurry, it takes soil nutrients with it. If you can **slow** that water down, **spread** it out, and **sink** it into the ground, your soil will keep its

nutrition as well as a water supply to tide your plants over through droughts.

Pay attention to how water flows off your property during a heavy rain. Where is it coming from? How could you slow it down — say by digging a subtle trench across the grade, just an inch or two high? **Start at the top of the slope** and work your way downward, and you'll be surprised what a difference this makes!

If the only slope on your property is your roof, consider installing a few rain barrels to catch some of the water for later. But be sure to direct the extra water safely away from your house foundation!

What if you don't have any lawn at all? Save some of the water from rinsing or boiling vegetables, and (once it's cooled off) use it to water your houseplants instead of straight tap water. Rinse water may contain microbes that helped keep those veggies healthy, and boil water contains nutrients lost from those

veggies during cooking, and as an added benefit, any chlorine in it has boiled out. See also, “Water plants with rainwater.”

3. Don't till or spray

I realize this is a tough sell when the conventional practice for decades has been to till and spray. But the evidence keeps coming in that these practices are harmful to soil health, and convention is starting to catch up!

Tilling physically destroys the mycelial (fungal) network living in the soil and promotes bacterial decay, which is great when you need a quick burst of fertility for your plants, but it comes at the long-term expense of the soil ecosystem. Soil that is tilled year after year has less microbial diversity, more compaction (requiring more tilling!), and poorer water & nutrient retention than soil that has not been repeatedly tilled. The good news is, you can cut down or stop! When planting, disturb the soil just enough to cover your seeds to the desired depth; when removing unwanted plants, chop them off at ground level (*e.g.* with

a hoe) rather than pull them up so that the roots decay in place; and keep the ground covered with a generous layer of mulch except while your seeds are germinating. These practices encourage a soil ecosystem that can keep the ground soft and workable without tillage.

Instead of spraying **herbicides** (weed killers), cut down unwanted plants before they go to seed, or learn to tolerate them. Many common weeds are nutritious foods for people and/or wildlife, and most of them actually leave the soil better than they found it!

Instead of spraying **insecticides** (bug killers), attract predatory insects to your property by planting aromatic herbs (that is, any plant that has a fragrance) and perennials that generate a lot of leaf litter such as comfrey. If you don't mind garter snakes, make them a home with a pile of rocks, and they will eat bugs and mice for you all season. If you're still having insect problems, read up on organic garden pest control!

Why are chemical **fertilizers** bad for soil health? In a nutshell, they disrupt the symbiotic relationship between plants and soil microbes, much as tilling does. Instead, apply composted yard waste or manure to the soil surface at planting time. Compost is not just fertilizer -- it's got billions of living microbes (much like yogurt!) which will continue extracting nutrition from the mineral soil throughout the season.

If you don't have a yard, you can feed your houseplants organic compost instead of Miracle-Gro, and treat bug infestations by simply putting potted plants outside for a few hours -- most indoor pests, such as spider mites, are opportunists that can't survive outdoors.

4. Promote biodiversity

There is an undeniable aesthetic appeal to having only one kind of grass in your lawn and only one kind of plant growing in each garden bed. It looks neat and tidy, like a formal European garden. But from an ecological perspective, a monoculture is a disaster. What kind of plague must have swept through to leave only a single kind of plant alive? A uniform field of sameness is also irresistible to pests like grasshoppers, harlequin bugs, and downy mildew, which can easily travel from one plant to the next.

The soil ecosystem cannot stay healthy when fed by only one kind of plant, which is why farmers throughout history have rotated their crops. Another approach is to plant a polyculture, more than one kind of plant in the same space at once. This is more challenging to harvest, but it means you don't have to

worry about keeping track of what you planted where each year, because the soil doesn't get "tired" in the first place.

Nature does her best to address the soil deficiencies caused by monoculture, for example by planting clover and dandelions in your lawn! If you don't mind the aesthetics of a diverse lawn, you'll be rewarded by greener grass with less watering and no need of fertilizer — signs of higher organic matter in your soil.

If you grow plants in containers instead of in the ground, you can still do companion planting. Growing basil and onions with tomatoes, for example, is a slam dunk! Even if you don't grow plants together in a pot, you can get many of the same benefits by placing a variety of potted plants together, so that all the tomatoes are not next to each other, etc. And don't reuse the same soil for the same (annual) plant two years in a row: plant something else in that soil next year.

5. Keep green plants growing year-round (cover crops)

Green plants are the sunlight for the underground ecosystem. Lacking exposure to the actual sun, soil critters get their sunlight second-hand, in the form of sugars made by photosynthesis. Only green plants can photosynthesize, so wherever you see a green plant growing, there's a whole community of soil life in its roots, and where you don't, the soil life is going hungry. There's even some evidence that humus can only form in the presence of living plant roots!

The plants we call evergreens (for example, pine or sage), true to their name stay green all year, but deciduous perennials (such as maples or forsythia) and annuals (most garden vegetables) leave the ground bare for part of the year. This means you have an opportunity

to improve soil health by planting something — virtually anything — that grows during that bare time of year.

Under a deciduous tree, consider planting **ephemeral bulbs** such as daffodils or surprise lilies, which do all their photosynthesizing for the year before the trees leaf out in the spring. You can also plant **shade-tolerant perennials** such as hostas or currants to get an early start on spring but stay green through the summer. Of course, many types of grass also stay green year round in our climate, so grass is an option in all but the deepest shade.

In the garden, you can squeeze in an early or late crop of radishes, lettuce, or spinach before or after your summer crops, or plant something that stays green through the winter and can be harvested (or just mowed down) in spring, such as winter wheat. I like to keep a constant cover of white clover on the garden beds — when it's time to plant something else, I just pull up clover by the handful and plant

right in it, and then I put the clover back down as a mulch to protect the soil while the seeds are germinating!

Finally, consider letting the weeds grow until you're ready to plant. Most of them (with a few exceptions!) don't do any harm, and henbit and creeping charlie are really kind of pretty. If anyone asks what those weeds are doing in your garden, tell them they're improving the soil and feeding the bees!

6. Keep the ground covered in mulch

Sometimes it's not possible to keep a living groundcover on the soil, but the next best thing is organic mulch. It doesn't supply the same photosynthetic sugars that living plants provide, but it does keep the soil ecosystem fed and frisky!

There are two basic types of organic mulch: green and brown. **Brown mulch** (*e.g.* wood chips or last year's leaves) has lost its protein and is mostly carbohydrate (carbon), which feeds the soil fungi, creating a more acid soil preferred by woody plants such as trees and shrubs. **Green mulch**, (*e.g.* grass clippings and weeds without seeds), is still high in protein (nitrogen), which feeds the soil bacteria, creating a more alkaline soil preferred by non-woody plants such as vegetables and flowers.

What this means is, if you have a choice of mulching material, use the green mulch on your vegetables and flowers and the brown mulch on trees and shrubs. Brown mulch is also excellent in paths, because it suppresses most weeds.

Some non-woody plants have earned a reputation as “**mulch plants**” because they grow long leaves or stems and then fall over or die back, suppressing other plants for several feet around unless you tidy them up. If you harvest these leaves several times a year and use them in the garden, you can keep the plants looking tidy *and* mulch your soil in one step! Perennial mulch plants for the garden include comfrey, tansy, and daylilies, among others, while ranchers like to use annual cover crops such as cereal rye or vetch.

You can use **mulch in containers** as well, to reduce the need for watering. Just be aware that mulch is full of life, so you might be bringing a few bugs into your house!

Spoiled hay makes a great green mulch for large areas. Avoid brome hay, as it may contain seed you wouldn't want in your garden. Prairie hay works great, but when buying hay from a farmer make sure to specify that you want it for mulch rather than for feed. Not only are the spoiled bales less likely to sprout unwanted seeds in your garden, they may be discounted in price. Pile the hay deep (3-6 inches), as it will quickly settle.

Straw is readily available and is tempting to use as a brown mulch. However, in addition to possibly containing grain that will sprout and grow (this is not necessarily a bad thing), it may also contain herbicide residue that will prevent your vegetables and flowers from growing for months or even years. If someone gives me a strawbale for free, I usually let it sit out in the rain for a year or more before I use it, and even then I use it in the path rather than in the garden!

7. Compost

A lot of people think of composting just as a way to dispose of unwanted waste from the yard and kitchen. You can use a compost that way, but that's a *waste* of its other fine qualities!

When you compost your waste, what you're really doing is **feeding an ecosystem** of microbes and other soil critters: not just bacteria and fungi, but earthworms, centipedes, springtails, nematodes and many others. That may sound creepy and gross, but it's just what your soil needs to be healthy and grow healthy plants.

To grow a balanced soil ecosystem, you need to **feed it a balanced diet** of green matter (high in protein / nitrogen, *e.g.* kitchen scraps, weeds, and grass clippings) and brown matter (high in carbohydrate / carbon, *e.g.* dead leaves, straw, sawdust, and shredded

newspaper) — but also some dirt to supply other minerals, and plenty of air and water. If your compost smells bad, add more brown matter.

Tutorials on composting usually encourage you to make a **hot compost**, which decomposes so rapidly that it kills off not only weed seeds and pathogens, but most helpful soil organisms as well! That's great if you're just trying to make fertilizer rather than a complete ecosystem; I prefer to keep the party going all season long, with all my guests alive, by including some sticks that take a long time to break down. As long as there's plenty of air in the mix, the helpful microbes will overpower the pathogens.

One point that's often overlooked is that if you want to cultivate an ecosystem that supports living plants, you have to feed it with **living plant roots**: when making humus, there's no substitute for the sugars that only photosynthesis can produce. So it may be

counterintuitive, but if there aren't plants growing in your compost, there's something missing! For this reason, one of my favorite ways to compost is directly in the garden beds, a technique called sheet mulching. Sheet mulching is often used to prepare a new garden bed, but you can also mulch around your growing plants and make compost right where they need it. As an added benefit, you don't have to turn the compost!

If you don't have a yard or garden, you can compost indoors using a special breed of earthworms. When it's done properly, vermicompost doesn't smell and produces exceptionally strong fertilizer which should be mixed with soil before use.

8. Water plants with rainwater

There are a number of good reasons why rainwater is best for the soil — and they're all flip sides of the reasons why municipal water is best for drinking:

- Rainwater doesn't have **chlorine** or **chloramine**, which are in municipal water to keep bad bacteria from growing in the pipes, but which also can kill good bacteria in the soil.
- Rainwater is slightly **acidic** (low pH), which most plants prefer because our limestone-derived clay soil tends to be slightly alkaline (high pH). Well water and some rural water supplies that come from underground may be very alkaline because of the limestone aquifers.
- Rainwater picks up modest amounts of **soluble nutrients** like nitrogen and phosphorus from the air (and from bird

droppings on your roof and debris in your gutters) on its way to the soil, whereas treated water has these nutrients removed, again to keep bad stuff from growing in it.

So if you have a garden or lawn to water, and you have the ability to catch some rainwater from your roof, it's a good idea to water your plants with it, and *not* to drink it!

I have reservations about recommending people add rain barrels directly to their downspouts, because I've seen too many of them overflow into people's basements during heavy downpours. Instead I recommend either my Ultimate Rain Barrel System or Simpler Ultimate Rain Barrels (see links in the glossary). If you don't follow those designs, please at least read the reasoning behind them. I'd hate for your basement to get flooded!

If you don't have access to rainwater, you can improve your tap water before using it for irrigation. First, call your water department

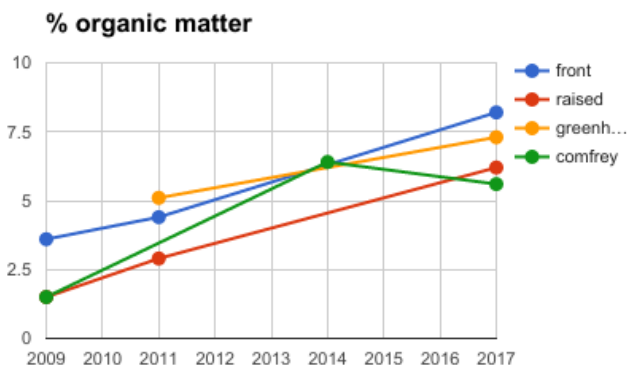
and find out whether your tap water is treated with chlorine or chloramine. If it's just chlorine (like Emporia's city water), all you have to do is let it sit for 12-24 hours, and the chlorine will off-gas. If there's chloramine in your water, you can neutralize it with vitamin C (approximately 1 tablet for a barrel of water), which has the added benefit of lowering the pH a bit.

Some people advocate reusing "greywater" from washing dishes or showering, but this is liable to be quite alkaline from the soap, and there are hygienic considerations that are beyond the scope of this book.

9. Test your organic matter again

If it's been a year since you tested your soil, and you've taken any of the advice in this book since then, now it's time to get an "after" measurement to see whether what you did made a difference.

Below is an example of what you might see if you graph your %OM over time. You can read more about these particular locations on my blog (see the link in the glossary), but you can see at a glance that all four are increasing in organic matter over time. If you have "mulch plants" like comfrey, you may see a more rapid increase in the first five years or so followed by a decline when the plants reach mature size, as you can see on the graph.



If you're feeling scientific, you may want to test another part of your property as well, where you did not follow the advice in this book, in order to see whether it also improved. I'd love to see your results! Please contact me at ben@interdependentweb.com.

10. Buy from responsible farmers and ranchers

I hope you've seen that there are things you can do on a home scale to rebuild soil.

However, it's also true that you can't do as *much* good as a farmer or rancher who has much more soil to work with. Fortunately you can magnify your impact by encouraging your local farmers and ranchers to try these practices, by asking them how they farm and spending your money accordingly.

Go to your local farmers market, for example our excellent Emporia Farmers Market, and talk with the vendors about how their food is grown or raised. Keep in mind that some crops are much more susceptible to pests than others, so for example you're unlikely to find a farmer with sweet corn or squash who doesn't spray, but someone who grows berries or herbs may neither spray nor

till. I'll go out on a limb and say that as a rule of thumb, the farmers with **the greatest variety of produce** at market are the most likely to be paying attention to their soil health.

When buying eggs from a farmer, **ask how the chickens live**. "Free range" means different things to different people. The more freedom chickens have to decide what they eat in a given day, the more likely they are improving the soil as well as looking after their own health, which means better quality eggs for you.

Similarly, "grass fed beef" may conjure up images of cattle ranging freely on the prairie, but it could also mean the cows are eating bales of hay indoors, so ask about that. Keep in mind that free ranging of any livestock is actually not as good for the soil as **intensive, mob grazing** that allows the plants to fully recover before they get grazed again.

If talking to every producer in the market sounds like a lot of work, consider joining a Community Supported Agriculture (CSA) farm, so that most of your produce for the season comes from a single farmer or group of farmers. Local Harvest is an excellent site for finding CSA farms in your area.

You may be wondering whether you can get these products at the supermarket instead of the farmers market. Unfortunately, a label that says “organic” or “free range” or “natural” gives you no information about how the soil was treated. **We don’t yet have a label for that!** So for now, if you want to make soil health a priority, you need to talk to the farmers and ranchers personally.

11. Spread the word

Finally, you can multiply your impact by sharing this book with others. If following these guidelines has improved your soil health, improved your harvest, reduced flooding and droughts, or just made your gardening or yardwork more pleasant, let your neighbors and friends and family know!

Glossary and Further Reading

Since you're reading this book on paper, here are the links that would have been in the text of the online edition, in an easy-to-type format, with some explanation.

- **Community Supported Agriculture (CSA):** A popular way to turn veggie farming from a risky business into a win-win.
https://en.wikipedia.org/wiki/Community-supported_agriculture
- **Crop Rotation:** The time-tested practice of changing up what grows on a plot of land is well explained, along with related concepts, at
https://en.wikipedia.org/wiki/Crop_rotation
- **Emporia Farmers Market:** Your local source for farm-fresh produce, and a great place to talk with farmers about their practices.

<http://www.emporiafarmersmarket.org/>
or 620-343-6555

- **Fuller, Gail:** Emporia's local expert in building soil through grazing and cover cropping. <https://tinyurl.com/gail-fuller>
- **Haney test:** A soil health test designed to mimic nature's approach to soil nutrient availability.
<https://www.wardlab.com/haney-info.php> or (800) 887-7645
- **Humus:** A spongy, black substance made by soil microbes out of dead plant matter in the presence of living plant roots.
<https://en.wikipedia.org/wiki/Humus>
- **Liquid Carbon Pathway:** Dr. Christine Jones's term for how green plants feed the soil ecosystem to produce humus. Read the PDF at <https://tinyurl.com/liquid-carbon-pathway>

- **Local Harvest:** a national directory of local farmers, as well as markets and stores that carry their products.
<https://www.localharvest.org>
- **Lyon County Extension Office:** 2632 W Hwy 50, Emporia KS 66801, 620-341-3220. <http://www.lyon.k-state.edu/>
- **Permaculture** is a design science that aims to construct ecosystems that can support people indefinitely.
<https://en.wikipedia.org/wiki/Permaculture>
- **Noxious Weeds** are plants that the state government has found do not play well with others in our climate. In Kansas:
<https://tinyurl.com/KS-noxious-weeds>
- “Organic **Pest Control**: What Works, What Doesn’t.” Mother Earth News, 2011. Based on a nationwide survey.
<https://tinyurl.com/MEN-pest-control>
- **Rain Barrels:** Learn about the “Ultimate Rain Barrel System” and why

most rain barrels are problematic, at <https://tinyurl.com/ultimate-rain-barrels>

- **Sheet Mulching:** My favorite way of composting and preparing garden beds at the same time! Read more at https://en.wikipedia.org/wiki/Sheet_mulching
- **Soil Test Results** after 9 years of no spray, no till gardening at Interdependent Web Urban Farm in Emporia, the reason I'm confident writing this book: <https://tinyurl.com/soil-tests-NSNT>
- *Effect of **tillage** on soil biodiversity* by Sahar Sheibani and Ahmad Gholamalizadeh Ahangar, 2013. PDF at <http://jnasci.org/wp-content/uploads/2013/08/273-281.pdf>
- **Vermicomposting:** By keeping a special breed of earthworms in a container in your home, you can make compost indoors year-round. Learn how

at

<https://en.wikipedia.org/wiki/Vermicompost>

- *Weeds, Guardians of the Soil* by Joseph A. Cocannouer, 1950. PDF available at <https://tinyurl.com/weeds-guardians-soil>